NETWORK STATUS REPORTING METHOD AND A COMMUNICATIONS NETWORK

The present invention relates to a method for network status reporting as described in the preamble of claim 1, the communications network as described in preamble of claim 2.

Such a method and communications network are already known in the art, e.g. from the section Flow Control Model and Service Model for the ABR Service Category, pages 7-11 in *"Traffic Management Specification Version 4.0"* from the author Natalie Giroux published in April 1996 by the ATM Forum (ATMF) Technical Committee.

Therein, the Available Bit Rate flow control is described. This Available Bit Rate flow control occurs between a data source, called a sending end-system and a data sink, called a receiving end-system. A data source and a data sink are connected via bi-directional connections over a communication network containing a number of intermediate network nodes, called network elements. In this Available Bit Rate flow control method, the intermediate network nodes and the data sink report to the data source on congestion in the communications network.

A source generates forward RM-cells, which are turned back by the data sink and sent back to the source as backward RM-cells. These backward RM-cells carry feedback information provided by the intermediate network nodes and the data sink, to the data source. An intermediate network node directly inserts feedback control information into RM-cells when they pass in the forward or backward direction and indirectly informs the data source about congestion. The data sink will update this congestion information in RM-cells , and generate backward RM-cells. The data source then adapts its traffic in accordance with the feedback in order to get a low cell loss ratio.Determination and reporting of network congestion by each of the intermediate network nodes together with the data sink in this flow control method, leads to a very complex

approach. At present the stability of this approach is not proven. Moreover, the complexity it introduces into the network is considerable. Besides, it is not possible to support this mechanism in a heterogeneous network hosting different transport technologies such as Asynchronous Transfer Mode and Frame Relay as it requires all the nodes involved, to support the ABR mechanism.

An object of the present invention is to provide a network status reporting method of the above known type and a communications network but whose implementation is less complex and which consequently can be introduced in a heterogeneous environment , like the internet.

~~According to the invention, this object is achieved by the method as~~ described in claim 1, the communications network as described in claim 2, the ~~data source as described in claim 6 and the data sink as described in claim 7.~~

In this way, by only introducing functionality in the data sink that is able to report network status information to the data source to thereby enable the data source to adapt the sending rate, and introducing functionality in the data source in order to interpret the notification and to subsequently adapt the transmission rate, the data loss rate is decreased and because only the data sink and the data source are involved, there is no additional complexity within the communications network. The intermediate network nodes are switching or routing network nodes constituting the backbone network, only participating in the method for so far that a received report is forwarded.

Because only the edge network needs adaptation, the current invention can be implemented in any heterogeneous network, like the internet.

~~Other characteristic features of the present invention are described in claim 3 and claim 4.~~

The data sink may be either the line termination element of an access network, such as an ADSL (Asymmetric Digital Subscriber Line) DSLAM (Digital Subscriber Line Access Multiplexer) or the network termination element of an access network, such as an ADSL modem, within the

communications network. These are alternative solutions for the implementation of the data sink.

~~A further characteristic feature of the present invention is mentioned in the claim 5.~~

The network status is determined based on the current data transmission rate on the line between the line termination element and the network termination element in an access network within the communications network. In case of a rate adaptive digital subscriber line network the RADSL modem and the RADSL Digital Subscriber line Access Multiplexer (re-)negotiate an upstream and downstream data rate over the line in between. In this situation the network neighbourhood of the data sink is the ADSL line in between the ADSL modem and ADSL DSLAM. The status of this ADSL line may be the data rate. Another network status in its neighbourhood may be the quality of signal received by the data sink that may be observed by monitoring loss of frames or a bit-error rate at the data sink.

An alternative network status in its neighbourhood, may be the data rate in case of Inverse multiplexing for ATM wherein the data rate mainly is determined by the number of active physical interfaces grouped into one logical interface. Here the number of active physical interfaces are monitored.

~~Additional characteristic features of the present invention are described in claim 8 and claim 9.~~

The network status reporting method is either initiated by the data source through the requesting for a report on the network status of the communications network or initiated by the data sink by sending a report on the network status of the communications network. These are alternative solutions for the triggering of the network status reporting method within the communications network. If the data source initiates the request for a report, the disadvantage is the use of network bandwidth for sending the request for a report over the path between the data source and the data sink and besides the delay of receiving the request for a report. Moreover the request may be

redundant because there may not be any status change at the data sink neighbourhood. On the other hand, if the data sink initiates the status reporting method the reporting may be done only when a status change has occurred and additionally there is no superfluous bandwidth consumption.

The above and other objects and features of the invention will become more apparent and the invention itself will be best understood by referring to the following description of an embodiment taken in conjunction with the accompanying drawing FIG. 1 representing a communication network wherein the network status reporting feedback method of the present invention is implemented.

In the following paragraphs, referring to the drawing, an implementation of the present invention will be described. In the first paragraph of this description, the main elements of the communications network as presented in FIG. 1 wherein the execution of the method for network status reporting, is described. This part is succeeded by a description wherein all connections between the before mentioned network elements and described components are defined. In the following paragraph the actual execution of the network status reporting is described.

The essential elements of the communications network of the embodiment according to the present invention are at first the user terminal UT, a rate adaptive asynchronous digital subscriber line modem RADSLM, a digital subscriber line access multiplexer DSLAM, the internet network INNW and at last the internet service provider server ISPS.

In order to keep simplicity in this description it is chosen to describe only one user terminal UT although there is normally a plurality of user terminals present in such a communications network. In this embodiment this user terminal is a personal computer. Further, also in order to keep simplicity in this description it is chosen to only describe one rate adaptive asymmetrical digital subscriber line modem RADSLM that handles the conversion of the rate adaptive asymmetrical digital subscriber line-signal, the rate adaptive

asymmetrical digital subscriber line further referred to as RADSL, into a format accessible for the present user terminal UT. The rate adaptive asymmetrical digital subscriber line modem RADSLM is able to detect the influence of environmental factors such as weather conditions and radio frequency interference, on the signal-quality on the line between the rate adaptive asymmetrical digital subscriber line modem RADSLM and the a digital subscriber line access multiplexer DSLAM. In reaction on a quality of signal change the rate adaptive asymmetrical digital subscriber line modem RADSLM may start a re-negotiation with the adjacent digital subscriber line access multiplexer DSLAM in order to change the data rate on the meant ADSL-line.

The digital subscriber line access multiplexer DSLAM present, handles the linking of many customer Rate adaptive asymmetrical digital subscriber line connections to a single Internet protocol link and vice versa. It participates, as mentioned before, in the re-negotiating a data rate between the digital subscriber line access multiplexer DSLAM and the rate adaptive asymmetrical digital subscriber line modem RADSLM. The internet protocol is further referred to as IP.

Further there is an internet network INNW present containing a number of intermediate network nodes, that are not presented in FIG. 1. These intermediate network nodes are constituted by either routing or switching network elements.

Still there is an internet service provider server ISPS, which is a network element at the service provider premises and is able to send data with an adaptable data transmission rate towards a requesting user.

The internet service provider server ISPS is coupled to the internet network INNW via an IP-link. Further the intermediate network nodes are all interconnected via IP-links. The digital subscriber line access multiplexer DSLAM is also coupled via an IP-link to the internet network INNW and the digital subscriber line access multiplexer DSLAM is coupled via a common

known PSTN twisted pair copper wire to the RADSL modem and the user terminal is coupled to the RADSL modem.

In order to explain the operation of the present invention it is assumed that the internet service provider server sends data via the internet network INNW and the digital subscriber line access multiplexer DSLAM towards the rate adaptive asymmetrical digital subscriber line modem RADSLM that hands over the data to the user at the personal computer UT. This data transmission is performed at a certain data rate.

Later, at a certain point of time, the weather conditions get worse, hence also the quality of signal on the ADSL-line decreases. As a result the rate adaptive asymmetrical digital subscriber line modem RADSLM and the digital subscriber line access multiplexer DSLAM re-negotiate another, lower transmission rate on the ADSL-line. If the internet service provider server ISPS continues transmitting data at the same rate there may be loss of data because of the reduced transmission rate at the ADSL-line. To avoid this situation, the rate adaptive asymmetrical digital subscriber line modem RADSLM sends a report towards the internet provider service server ISPS over the internet network INNW. The intermediate network nodes of the internet network forward this report according to well-known IP routing techniques. At reception of the meant report by the internet service provider server ISPS this server adapts its transmission rate based on the current transmission rate indicated by the received report.

It is to be remarked that in another embodiment, the initiative for reporting may be undertaken by the digital subscriber line access multiplexer DSLAM instead of the rate adaptive digital subscriber line modem RADSLM.

A further remarked is that instead of the data sink, the digital subscriber line access multiplexer also may apply the network status reporting to the data source.

A subsequent remark is that the network status reporting also may be applied in other rate adaptive networks but also in completely different

networks than the in this embodiment described ADSL access network, such as a mobile network like Global System for Mobile communication, further referred to as GSM, wherein the network status may be the data rate on the mobile link between a GSM terminal and an "adjacent" base station. The network status here, may be determined by the data sink which in this situation may be the mentioned "adjacent" base station or even the GSM terminal itself.

The present invention may also be applicable within a satellite communications network and the adjacent terrestrial network.

Although the above embodiments of the invention have been described by means of functional blocks, their detailed realisation based on their functional description should be obvious for a person skilled in the art and is therefore not described.

While the principles of the invention have been described above in connection with specific apparatus, it is to be clearly understood that this description is made only by way of example and not as a limitation on the scope of the invention, as defined in the appended claims.